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Introducing the i2 Technologies Approach to Effective Demand Management

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Table of Contents

Demand Planning	2
A Multidimensional Business Challenge	4
RHYTHM Demand Planner: The Multidimensional Solution	5
An Open Client/Server Architecture	9
Extending Demand Planning	12
Conclusion	14

Demand Planning

Introduction

Demand planning is one of the most critical challenges facing any manufacturer or distributor. In fact, successfully determining which of its products will be needed where, when and in what quantities can have an enormous impact on an organization's ability to maximize competitive opportunities, revenues and profits.

Effective demand planning involves several key steps:

- creation of a demand plan
- adjustment of the plan as necessary
- performance analysis and assessment
- upstream and downstream plan utilization

To help organizations master the challenges inherent in demand planning, i2 Technologies (i2) provides world-class solutions that efficiently integrate all the systems, processes and people that impact demand. We offer two principal products, each backed by an ISO9000-certified development process:

- RHYTHM Demand Planner – a multidimensional planning application supporting demand planning and demand replenishment
- RHYTHM Demand Analyzer – an ad-hoc end-user analysis tool supporting exception-based analysis with filtering, ranking, sorting, and graphing
- RHYTHM Demand Administrator – a client/server, GUI based application to manage the underlying multidimensional data engine.

The i2 approach to demand planning reflects our conviction that accurate demand planning starts with a sound process that involves all persons and data that add value to demand planning.

Simply put, demand planning is the process of uniting planning input from individuals who span the different functional areas within an organization, as well as input from external sources such as distributors and customers. We believe that integrating multiple functional perspectives into the demand plan from the start increases the plan's accuracy and ultimately enhances both revenues and profits.

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Unlike traditional demand planning systems that provide single-number results through "black box" statistical routines and limited data views, RHYTHM Demand Planner enables users to support all aspects of demand management at any data level, through any view. Users benefit from a number of industry best practices, including:

- identification of all people who add value to the demand planning process
- aggregation of all planning inputs
- arbitration and alignment of all individual demand plans
- allocation and population of all detail levels for effective enterprise wide plan utilization

In short, i2 solutions empower customers to create and influence demand both profitably and efficiently.

A Multidimensional Business Challenge

Because each functional group within an organization has its own perspective on planning product and customer demand, the process is inherently multidimensional.

A company's marketing group, for example, might need to view demand for all product families and customers over a one to two-year period, while the sales force might be most interested in certain key customers' demand for all products over a period of 12 to 18 months. A logistics planner will have still another perspective, perhaps involving plant-by-plant product demand over a short-term period such as 12 weeks. Each functional area, however, views demand from the perspective of three primary dimensions: product, customer/geography and time.

As a multidimensional process, demand planning has many of the requirements of an OLAP (on-line analytical processing) or decision support application. These requirements include the need for users to:

- slice and dice historical and forecast data
- view and manipulate data from different perspectives over multiple time periods
- drill down into data
- consolidate upward
- review and reconcile inputs from various levels

Such flexibility is essential for answering the questions typically asked during the process of demand planning. For example, a planner might wish to see the implications of a 5% increase in demand for a particular product line in a single key account—a question with multiple implicit dimensions. Of course, this planner will want to view the impact of such an increase not only on all products within the product line specified, but on all customer channels, as well.

"What-if" demand planning questions such as this one are efficiently answered with a multidimensional OLAP engine, which can aggregate and disaggregate data to provide rapid answers to questions involving complex relationships over a given time period. Unfortunately, however, traditional demand planning solutions have been based on a relational data model—an extremely inefficient tool for analyzing relationships between products and customers/geographies over time.

RHYTHM Demand Planner: The Multidimensional Solution

Before OLAP and multidimensional technology became the industry standards they are today, i2 recognized that multidimensional modeling was the only way to provide the flexibility and performance necessary for true collaborative demand planning. Because our products were designed as multidimensional solutions from the start, they incorporate features that still distinguish them from other OLAP multidimensional engines.

Updates and Allocations

The RHYTHM Demand Planner engine provides users with an unmatched ability to perform real-time sophisticated updates and what-if modeling. For example, users can even obtain answers to such highly specific questions as "How will a 10% increase in the Northeast territory affect my overall sales forecast, and what is the most efficient technique for making that update?"

The sophisticated, top-down allocation capability of RHYTHM Demand Planner can be used to allocate updates for any intersection of product, customer/geography and time period. The engine will also pick the allocation technique with the least error, eliminating the need for the user to make that calculation. When an allocation is performed, the engine will propagate those updates throughout the multidimensional cube. Users can also perform "bottom-up" and "middle-out" updates to make certain that current information is distributed up, down and throughout the multidimensional data cube. All updates will also be percolated upward, ensuring that all levels aggregate properly.

Multiuser Write Arbitration

In addition to permitting top-down allocation, RHYTHM Demand Planner enables multiple users to perform updates and what-if modeling simultaneously through unique multiuser write arbitration functionality. This capability ensures that all levels of the multidimensional data cube remain synchronized, regardless of how many users are updating data simultaneously.

Multidimensional Efficiency

The flexibility and efficiency of RHYTHM Demand Planner result from the product's underlying multidimensional technology. In fact, these benefits would be impractical—if not impossible—to achieve through a relational data model.

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In a relational model, data is represented in two dimensions—an excellent structure for transaction processing, reporting and simple data inquiries. However, accessing data represented in only two dimensions is an impractical, inefficient strategy for answering complex questions such as those involved in demand planning. To quote E. F. Codd, who developed the relational database concept in 1970 and later became an advocate of OLAP technology, "Relational database management systems ...were never intended to provide powerful functions for data synthesis, analysis and consolidation (functions collectively known as multidimensional data analysis)."¹

For example, simply running a forecasting model over several years of history at a product family level would tax the capabilities of a relational solution. Likewise, a relational model does not allow users to access and update multiple rows of data simultaneously. Rather, relational technology restricts users to single updates, making updates that involve many rows of data much slower than those executed in the i2 multidimensional engine.

The efficiencies offered by RHYTHM Demand Planner derive from the preaggregation and indexing supported by a multidimensional model, which provide users with direct access to any intersection of product, customer/geography and time. Additionally, RHYTHM Demand Planner takes advantage of memory-resident processing by caching indexes and control information, providing a further boost to performance.

Performance Superiority

The performance differences between multidimensional and relational database structures can be dramatic. To illustrate, i2 recently benchmarked RHYTHM Demand Planner against a comparable, relational-based solution, utilizing approximately one million rows of data. The multidimensional RHYTHM Demand Planner engine provided 2,500% faster navigation, 1,000% faster updates and 1,000% faster report creation while offering many allocation and bottom-up update capabilities simply unavailable in the relational solution.

¹ E. F. Codd, S. B. Codd and C. T. Salley, "Beyond Decision Support," *Computerworld*, Vol. 27, No. 30, 26 July 1993.

Flexibility and Delivered Functionality

RHYTHM Demand Planner offers the best of both worlds—delivered functionality along with a toolkit approach that enables applications to be customized for individual users. Our proven series of forecasting algorithms provides a variety of statistical models that can be used to create a demand plan. Delivered as parameter-driven Dynamic Link Libraries (DLLs), new algorithms are included as user options in drop-down list boxes. i2 solutions also give users the flexibility to import their own statistical models or calculations as DLLs, as well as develop ad hoc models with our modeling language which can be readily utilized without IS involvement.

Customized Dimensions and Views

Another important benefit offered by RHYTHM Demand Planner is the flexibility to define the basic dimensions of product, customer/geography, data, and time. The application may also be configured to support numerous views of the data within the product and customer/geography dimensions. This flexibility makes RHYTHM Demand Planner able to support a company in virtually any industry – as well as the various departments within a particular company.

Customized dimensions and views are built directly into the RHYTHM Demand Planner engine to maintain high-speed performance and the convenience of multiple, dynamic views without the need to define multiple versions of the application. For added flexibility, views can be added or modified quickly and easily through RHYTHM Demand Administrator.

Data Relationships

For many organizations, demand planning routinely involves multiple currencies and alternative units of measure such as cases and units. i2's multidimensional engine simplifies these planning requirements by establishing currency conversions or calculations for supporting multiple units of measure (such as defining that one carton is equivalent to four boxes). We offer two options for maintaining relationships between variables—establishing them into the actual data structure, or tracking them through expressions that allow users to alter variables as desired. Users can also automatically load currency exchange rates that will dynamically update the appropriate data in the i2 engine.

Composite Planning

Many organizations—particularly those in the high-tech and consumer goods industries—require the ability to do composite product planning, which involves planning and tracking both dependent and independent product demand. A hardware manufacturer, for example, might ship some of its PCs with a 15" monitor and others with a 17" monitor. For maximum planning accuracy, the manufacturer would likely wish to plan and track demand for the PC as well as for each of the monitors. While this requirement might frustrate certain demand management systems, i2's technology handles the challenge easily, thanks to its top-down allocation capabilities and ability to support relationships between specific products and data elements.

Pick Best

One of the most important—and time-consuming—responsibilities of any planner is evaluating the accuracy of different statistical modeling techniques. To streamline the process, RHYTHM Demand Planner incorporates a "pick best" function that automatically selects the statistical technique which produces the least error, based on a user-defined error calculation over a user-defined time horizon, for any forecast at any intersection of product, customer/geography and time. Besides improving forecast accuracy, this valuable feature easily eliminates hours of manual planning work.

An Open Client/Server Architecture

i2 applications are built on an open client/server architecture that enables them to integrate easily into any business environment. We utilize a server-centric model that supports server-based application logic with a "thin-client" providing the user interface.

Our "thin-client" approach makes RHYTHM Demand Planner easily deployable over a WAN and easily accessible via dial-up. With all application logic residing on the server, network traffic is minimized, providing extremely rapid response over a dial-up connection—a stark contrast to "fat-client" applications, or those based on older technologies such as screen scrapers or Xwindows.

RHYTHM Demand Planner supports client/server communication over standard TCP/IP or SPX. It supports standard server operating systems such as Windows NT, NetWare and various flavors of UNIX and features a graphical user interface that runs on Microsoft Windows 3.11, WinNT, Win95 or WinOS/2.

Object-Oriented Design and Development

Since its very first release, RHYTHM Demand Planner has been developed using an object-oriented approach. Later in this paper we will examine how this development process provides a variety of significant advantages as open standards evolve—advantages with important implications for our customers' integration and deployment, as well as our own product development.

The object-oriented RHYTHM Demand Planner development process uses C++ for both client and server. The client uses the Windows Multiple Document Interface framework to present the various objects.

Efficient Scalability

Effective demand planning requires the ability to support many users working concurrently with large amounts of data. RHYTHM Demand Planner is designed to accommodate hundreds of users working with years of history. It utilizes multiple threads to maximize available memory and hardware, delivering highly scalable applications that efficiently support the addition of data, users and demand plan elements.

A high-tech company in a stress test of our RHYTHM Demand Planner and RHYTHM Demand Analyzer products recently evaluated the scalability of i2 solutions. Running on a UNIX platform, they performed a battery of tests to compare various user, software, database and hardware configurations.

The tests demonstrated that:

- both RHYTHM Demand Planner and RHYTHM Demand Analyzer performed well under a stress workload
- workload could be doubled without any significant performance or throughput degradation
- numerous simultaneous updates had little effect on non-update functions
- a more powerful server for update transactions improved performance with a large user test group but had little impact on non-update functions

Based on these results, the customer concluded that RHYTHM Demand Planner more than met their performance and scalability requirements.

Easy Access to the Multidimensional Engine

The ease with which data can be inserted and extracted is one of the most significant attributes of any solution. For maximum efficiency, RHYTHM Demand Administrator—including our import and export functions—offers users the flexibility to input and access data at any level they require. Data can also be easily integrated with desktop productivity tools using DDE and OLE capabilities in the applications. Additionally, open access to the i2 engine is supported through an ODBC driver.

Full Integration with Other Applications

An important aspect of demand management is the ability to incorporate data that adds value to the planning process, regardless of its source. Examples include actual historical data from internal mainframe, midrange or PC-based legacy systems, as well as competitive information, financial data and industry information from third-party sources.

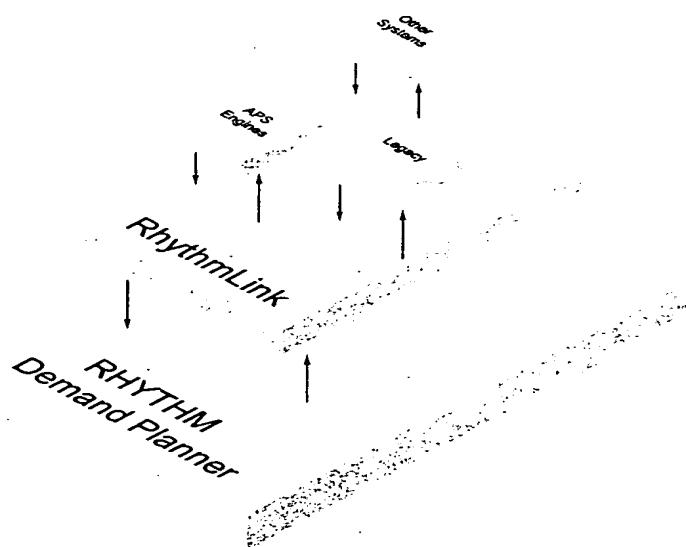
Unlike other demand planning systems, i2 solutions do not restrict users to predetermined interfaces or data. Our technology incorporates an open interface that can accept data from any source, including relational data warehouses. In fact, RHYTHM Demand Administrator combined with RhythmLink offers the advantage of being able to read and write information directly to and from relational warehouses.

In addition to providing the standard interfaces that usually run in the background, we offer users the flexibility to import and export data as they require. Our import and export objects allow users to determine the data they need interactively. Additionally, the DDE and OLE capabilities built into our applications enable users to easily integrate external data directly into the demand process.

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As part of the i2 Supply Chain Management suite, RHYTHM Demand Planner and RHYTHM Demand Analyzer take advantage of RhythmLink, i2's powerful integration tool that supports two-way communication between RHYTHM products and external sources. It offers database access, ODBC access, integration with legacy systems and full open architecture support through such standards as OLE, CORBA, DCOM and others.



Extending Demand Planning

Mobile Computing

With the explosive growth of mobile computing, more and more organizations are finding that individuals who could provide valuable demand-planning input are frequently located out in the field, unconnected to the network or lacking a steady connection to the server. Field sales reps are a great example.

i2's mobile computing object will allow such remote users to connect to the server and download their "slice" of data from the multidimensional engine using store and forward technology. Once this data is "checked out" and replicated, it is implicitly locked from update by other users. After disconnecting from the server, mobile users can create and analyze their plan on their laptop and then simply reconnect when ready to update their particular data segment.

i2's ability to implicitly lock data is an important business requirement that other multidimensional technologies have not solved. With i2's technology, however, the engine works around these data locks to permit updates to occur after users have checked out particular data segments. Once these segments are checked back in, the i2 engine ensures data integrity at all levels by making certain that each level aggregates and disaggregates properly. i2 also provides administrative capabilities that can manage locks for overrides, among other functions.

Internet-Based Collaboration

Demand planning involves cooperation among different groups within an organization, as well as the collection of input from external sources such as customers, distributors, suppliers and manufacturers—all of which must be synthesized to form an integrated supply/demand chain management solution. The Internet is the ideal vehicle for assimilating this broad-based planning input, offering easy access for remote users, efficient software distribution and reduced maintenance requirements, to name just several advantages.

i2 provides customers with Internet-enabled technology today. In fact, customers have two options for using the Internet to access RHYTHM Demand Management directly. The first is to use a third-party solution to dial up to an internal server that controls access to the application server. The more efficient and open solution is to use a Web browser interface to the RHYTHM Demand applications. This approach efficiently and cost-effectively maximizes the number and range of users who can contribute to the demand planning process.

Development Strategy

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Over time, i2 is delivering a variety of Internet-enabled objects that offer customers a phased approach toward implementation of a complete suite of RHYTHM Demand Management objects.

Our development strategy is geared to producing an Internet client in which the user has the flexibility to compose and "mix and match" objects on a customizable browser page. Offering direct access to data, these objects will be able to interact and synchronize with each other automatically. Each object placed on the web page will function as a component that could be connected to other components on the page, with changes made to any one object automatically refreshing the others.

Given current object architecture, the quickest and most beneficial strategies for meeting this design objective is through either Java or ActiveX components contained within a browser. Both approaches permit development of objects that function as components, and both provide the granularity needed to allow users to mix and match objects on the browser page. Objects created in this way will communicate—in compliance with CORBA and/or DCOM standards—directly with the RHYTHM Demand server, bypassing the browser and Web server. The Java approach will also provide a platform-independent Internet client with native support on browsers running on a variety of client platforms, including Windows, Macintosh, OS/2 and UNIX workstations.

Our object-based development approach enables us to reuse C++ development objects and convert them easily to OCX, and hence to ActiveX controls—one of the vehicles for developing Internet objects. This is our initial offering for a web browser interface, with Java Beans soon to follow.

With our object-based Internet development strategy, i2 is uniquely positioned to provide efficient Internet access today, as well as a cost-effective migration to the future. Other demand planning solutions based on older technologies and "fat clients" will need to invest heavily in development efforts to provide what we believe companies are looking for over the long term—an open Web browser architecture that adheres to evolving standards while maximizing current hardware and software investments.

By offering Internet-enabled demand planning today, i2 provides customers with a number of important benefits, including:

- enhanced collaboration through the involvement of nontraditional participants in the planning process
- reduced computing infrastructure costs
- a tighter link between customers and the supply chain
- improved information-sharing
- increased productivity

Conclusion

As manufacturers and distributors increasingly need to maximize the accuracy of their demand planning simply to remain competitive, demand planning has become a business necessity. It is a complex, multidimensional process that demands effective, multidimensional solutions. i2 Technologies has long recognized that multidimensional modeling is the only way to provide the flexibility and performance necessary to support effectively the different groups which add value to the demand planning process. Our solutions incorporate features that distinguish them from other multidimensional engines, including sophisticated updating and what-if modeling capabilities, multiuser write arbitration, and customizable dimensions and views.

Built on an open client/server architecture, i2 solutions offer efficiency, scalability and full integration with other applications. They also provide true Internet-enabled functionality today, as well as a clear migration path to the future, ensuring that they remain the most efficient and cost-effective way to extend the collaborative demand planning process to the widest range and number of participants possible. In short, i2 solutions add significant value to the vital process of demand planning, giving customers a competitive edge through technology that remains unmatched in the industry.

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